HEWLETT hp PACKARD

REFERENCE MANUAL

MAGNETIC TAPE SUBSYSTEM DIAGNOSTIC

for

7970B/C/E (9-track)
13181/13183 Interface

Manual Part No. 13181-90095
Microfiche Part No.: 13181-90096
Diagnostic Tape Part No.: 13181-16001, series 2040
Diagnostic Serial No.: 112200

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PRINTED: APR 1981

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1.0 INTRODUCTION

This diagnostic tests the combined functions of the 13181 or 13183 Interface Kit (controller and cable) and the 7970 Digital Magnetic Tape Unit. The diagnostic provides for checking tape speeds of 12.5, 25, 37.5, and 45 inches-per-second (ips).

2.0 REQUIRED HARDWARE

2.1 HP 21MX Series Computer with at least 8192 memory locations (8k of core).

2.2 Direct Memory Access (DMA or DCPC in 21MX Series Computers) is optional for 13181 interface, but is required for 13183 operation.

Note: 8k of core is required for the diagnostic, the old versions of the diagnostics (13181 and 13183) will not be obsoleted for use in 4k systems.

2.3 A paper tape reader or other loading device such as a magnetic tape unit is required for loading.

2.4 A teleprinter is required for operator design.

2.5 HP 7970 Magnetic Tape Unit(s) with interface (device to be tested) and scratch tape(s).

3.0 REQUIRED SOFTWARE

3.1 HP 7970 B/C/E (9-Track) Tape Unit/13181A or B /13183A or B Interface diagnostic binary tape, part number 13181-16001 and manual, part number 13181-90095.

3.2 Diagnostic configurator (HP product number 24296) binary tape, part number 24296-60001 and manual, part number 02100-90157.

4.0 PROGRAM ORGANIZATION

This diagnostic program consists of thirty-one (31) tests plus a control and initialization section. The initialization and control sections accept the select code and options required by the tests. The various tests are called into execution by the control section as sequential or selectable subroutines.

This diagnostic uses the Diagnostic Configurator program.

4.1 Configuration

The configuration section performs the following functions:

4.1.0 Turns off the interrupt system (CLC 0,C) and clears the tape controller to prevent spurious start-up during basic I/O testing.

4.1.1 Loads the I/O select code from the switch register and checks that the select code is greater than 7. If it is less than 7, a halt (102073) will occur. The operator must enter a valid select code greater than 7. If it is a valid select code, the select code and option bits are stored into location 116 octal.

4.1.2 Checks the option bits stored into location 116 for tape speed and interface type (13181 or 13183). If switch register settings are invalid a halt will occur (102072). If switch register bit 11 is set (for 13183) and there is no DMA (DCPC) available, error halt 102071 will result if bit 9 is clear. The operator must enter a valid select code and options. Step 4.1.1 will be repeated until selection is correct.

4.1.3 Updates all the related I/O instructions in the program which reference specific select codes.

4.1.4 The configuration section may be executed by starting the program at location 100. The configuration section may be bypassed by starting the program at location 2000. At the completion of the configuration section halt 102074 will occur to allow the operator to enter program option bits in the switch register. If the program is started at location 2000, the program is at the same point as if the program had been continued from the halt 102074 or from halt 102075 generated by setting switch register bit 9.

4.2 Test Control and Execution

The control sequence for the diagnostic allows the selection and execution of up to 31 tests. Location 135 octal will contain the current test number and location 150 octal will contain the current tape unit status. The contents of 150 will be displayed in the B-register during any error halt. Location 151 will contain the current subtest number. During any error halt, the A-register will contain the current subtest number which will be embedded in the upper half (bits 15-8) of the A-register. The current test number will be placed in the lower half (bits 7-0).

The following chart gives a list of useful memory locations:

LOCATION	CONTENTS
135	Current test number
150	Current tape unit status
151	Current subtest number
152	Current unit selected
153	Last command issued
154	Expected status

All tests are written in subroutine form. The subroutines are placed in a contiguous manner in memory. To execute the individual diagnostic test subroutines, the control program uses a table of pointers to determine the test location.

Since the diagnostic is switch register controlled, program option bits are monitored by the control program to determine operator changes in the diagnostic execution. Switch register bits 9, 12, 13 and 15 are checked by the control program. Bit 9 is checked by any test program which is quite lengthy. Bits 13 and 15 are not used by individual test sections. Bit 8 is checked by the control program during basic I/O testing and all other tests which require operator intervention. The test control and execution section performs the following functions:

4.2.0 Turns off the interrupt system CLC 0,C and clears the tape controller.

4.2.1 Outputs an introductory message preceded by a carriage return/line feed. No halt will occur after the message is output.

4.2.2 Checks bit 9 to initiate changes in the test sequence to be performed or to abort the present test being run. The A/B-register contains the sequence of tests with bit 0 of the A-register corresponding to test 0, bit 1 corresponding to test 1 etc. (See Table VIII).

4.2.3 If bit 9 is not set, the default set of 27 tests is executed. It should be noted that tests 28, 29, 30, and 31 must be selected by the operator. The default tests are stored in location 143 and 144 octal as shown below:

```
143          OCT 177777
144          OCT 007777
```

4.2.4 If switch register bit 9 is set a halt 102075 will occur to allow the operator to change the test sequence. If no tests are selected the A/B-register will contain the previously selected tests.

4.2.5 Puts halts (106077) in locations 2-77 octal. Also restores the 106077 halts in locations 2-77 prior to the execution of each test.

4.2.6 Checks locations 143 and 144 to determine if a test is to be run. If yes, it runs test: if no, it checks the next bit and continues to search for a selected test. In addition, location 135 will contain the test number of the test currently being executed. Updates and contents of location 135 with the current test number and the contents of location 151 with the current subtest number.

Checks the currently selected tape unit for on-line condition: If the unit is not on-line, it will select the next on-line unit or if bits 0-3 are set, will select the next sequential tape unit indicated by the switch register settings.

4.2.7 After running a selected test, bits 15, 9 and 13 of the switch register are checked in that priority for operator changes to the program running.

A description of each bit follows:

Bit 15 initiates a halt at the end of individual tests. The halt will be 102076. The A-register will contain the current test number.

Bit 9 initiates a return to user test selection. Halt 102075 will occur with the A/B-register containing the last sequence

of tests selected.

Bit 13 initiates a loop on the current test being executed.

4.2.8 At the completion of all selected tests, the diagnostic's test control section performs the following:

Checks switch register bit 12 to determine if a loop on the diagnostic was requested.

Prints the message "PASS XXXXXX" (if teletype present) and continues program execution if bit 12 is set. The pass count is cleared whenever the program is restarted from location 2000 octal.

NOTE: The test control and execution section begins at location 2000 octal in memory. The configuration section is bypassed by starting the program at this location.

Selects the next sequential magnetic tape unit or the next on-line unit selected on the switch register. If bit 12 is set, then the diagnostic will loop or if 12 is clear, then press RUN to continue. In any case, the diagnostic will be repeated using the next on-line unit.

4.3 Message Reporting

There are two types of messages, error and information. Error messages are used to inform the operator of a failure of the controller to respond to a given command or sequence. Information messages are used to inform the operator of the progress of the diagnostic or instruct the operator to perform some operation related to the controller function. In this case an associated halt will occur to allow the operator time to perform the function, the operator must then press RUN.

If a console device is used, the printed message will be preceded by a "E" (error) or "H" (information) and a number (in octal). The number is also related to the halt code when a console device is not available. Refer to Table II for specific details of various error messages.

Error messages can be suppressed by selection of the switch register bit 11 and error halts can be suppressed by switch register bit 14. This is useful when looping on a single section that has several errors.

Information messages are suppressed by switch register bit 10. Sections with operator messages and associated halts can be suppressed by switch register bit 8 or if in diagnostic loop mode, they are automatically passed.

4.4 Test Selection

The control portion of the program provides for the operator to select his own test or sequence of tests to be run. The operator selects switch register bit 9 to indicate he is ready to make a new test sequence selection. If the program is running, that test will be completed and then the program will halt. Now the operator loads the A/B-register with the tests desired. The A-register bit 0 represents Test 0 (Basic I/O), bit 1 represents Test 1, and so on up to bit 15 of the B-register which represents Test 31. The operator must then clear switch register bit 9 and press RUN. The operators selection will then be run. If the operator clears all bits or makes no selection, the standard sequence will be run. Refer to Table VIII for a list of test numbers and their corresponding A/B-register settings.

5.0 OPERATING INSTRUCTIONS

5.1 Setting Up the Interface

5.1.0 Consult the appropriate Operating and Service Manual for the 13181 or 13183 Interface to verify that the crystal and timing straps are correct, (manual part no.'s 13181-90000 (13181A), 13181-90901 (13181B), 13183-90000 (13183A), or 13183-90901 (13183B).

5.1.1 Install the interface and priority card (if needed) to enable the priority chain.

5.2 Loading Binary Tapes

5.2.0 If a configured Diagnostic Configurator binary tape is available, use binary loader and go to section 5.3

5.2.1 Load the Diagnostic Configurator binary object tape and configure it according to the Manual of Diagnostics (M.O.D.) for it.

5.2.2 Load the diagnostic binary object tape. At this point a binary tape of the combined configurator and diagnostic may be dumped using the configurator dump routine. Refer to the M.O.D. for the configurator dump routine operating instructions.

5.3 Configuring the Diagnostic

5.3.0 If a configured diagnostic binary tape was loaded go to section 5.4.

5.3.1 Load starting address 100 in the P-register.

5.3.2 Load the switch register with the select code of the magnetic tape unit (data channel), the tape drive speed, and interface type (see chart below).

SWITCH RIGISTER BIT	TABLE SPEED (IPS)
15	45
14	37.5
13	25
12	12.5
	Tape Interface
11	13183
10	13181
9	Non DMA (DCPC) for 13183
5-0	Select Code

5.3.3 Press PRESET (INT/EXT) and press RUN. The computer will run and then halt with 102074 in the Memory Data Register. If halt 102073 occurs the select code input was less than 7; correct the select code and press RUN. If halt 102072 occurs, Check tape unit options and press RUN. If halt 102071 occurs and bit 9 is clear, the 13183 diagnostic was selected and there is no DMA (DCPC) available. Correct switch register setting and press RUN.

NOTE: At this point the operator may dump the configured program. Refer to the Diagnostic Configurator M.O.D. for the configuration dump routine operating instructions. If this is done the operator must set the P-register equal to 2000 before continuing to the next section.

5.4 Running the Diagnostic

5.4.0 If a configured diagnostic binary tape was loaded, set the P-register equal to 2000; if not, skip this step.

5.4.1 Make selection of switch register options according to following Table I. If the switch register is cleared a standard test run is performed. If it is desired to change the tests to be run at this point, set switch register bit 9 and press RUN. Halt

102075 will occur. The A/B-registers may be set to the desired tests followed by clearing switch register bit 9. It is recommended that the standard run be performed initially before changing the tests selected.

5.4.3 Press PRESET (INT/EXT) and press RUN. The program will execute the diagnostic according to the switch register options.

An introductory message "7970-13181 Diag." or "7970-13183 Diag." depending on which diagnostic was selected, will be typed (providing the teleprinter was configured as described in section 5.2). The diagnostic will then be executed. If the tests requiring manual intervention from the operator are not suppressed (switch register bits 8 and 12) Then the following message will occur:

"H024 Press PRESET (EXT/INT), RUN" followed by the message:

"H025 BI-O COMP FOR DATA CH"

The message H024 then occurs again in connection with basic I/O test for the command channel, followed by the message:

"H025 BI-O COMP FOR CMND CH".

5.4.4 At the completion of the diagnostic and providing switch register bit 12 was not selected, the following message will occur:

"PASS XXXXXX"

followed by halt 102077 (A-register will be equal to pass count).

At this point, the operator may repeat the diagnostic by pressing RUN. If the operator wishes to change the tests being executed, he may set bit 9 of the switch register and press RUN. Halt 102075 will occur. He may then change the A/B-register to correspond to the tests desired.

The above procedures have assumed no errors have occured during the diagnostic run. If an error does occur, a message will be typed followed by a halt. The program may be continued by pressing RUN.

It is recommended that the diagnostic be run four times for each on-line unit (up to 4 units). The first time it is run,

the A/B-register and switch register should be clear. This allows a standard run of all diagnostic tests. Afterwhich, it is run with the A/B-register clear but switch register bits 8 (delete test which require operator intervention) and 12 (loop an diagnostic) set.

To delete tests with rewind commands embedded in them, see Table IX. This is useful if the operator wishes to have the diagnostic cycle until an EOT is reached.

If switch register bit 12 was not selected the computer will halt with 102077 in the Memory Data Register. At this point the A-register contains the pass count. To run another pass, the operator need only press RUN.

5.5 Selecting Tests

5.5.0 To select a new test sequence or to abort the program, set bit 9 of the switch register at any time. On completion of the current test or error message, the program will halt 102075.

5.5.1 Refer to Table VIII for A/B-register settings and their corresponding test numbers. Make a new selection in the A/B-register. Clear bit 9 and press RUN.

5.5.2 The new test sequence will execute.

5.6 Restarting the Diagnostic

5.6.0 If the program was halted for some reason in the middle of a routine, the program may be restarted at 2000 and proceed from section 5.4.1.

5.6.1 To reconfigure for a different select code (or channel) start from section 5.3.1.

NOTE: 8k of core (minimum) is required. If only 8k of core is available, the program can not be reconfigured and the maximum buffer length is a little over one-hundred (100) words.

If reconfiguration is attempted by restarting at 100, error halt 102070 will occur. If RUN is then pressed, the program will jump to 2000 and begin program execution.

5.6.2 If a trap cell halt occurs (106077 in Memory Data Register) and the reason for the halt has been determined, the program may be restarted at location 2000 and proceed from section 5.4.1.

6.0 TEST DESCRIPTION

See Table VIII for a summary of tests.

The following footnote symbols will be used throughout this section and the text will not be repeated on each page:

* Indicates this test requires operator intervention (bit 8 of the switch register deletes this test).

** Indicates this test will be deleted if a 13183 Interface is used.

*** Indicates this test will be deleted if DMA (DCPC) is not available.

Individual tests are outlined below:

6.1 Test 0 Basic I/O Tests *

Test 0 is used on both the command and data channel select code.

NOTE: CH means channel.

Subtest 1: Checks the ability to clear and set, and tests the interrupt system. The following instruction combinations are tested:

CLF 0 - SFC 0

CLF 0 - SFS 0

STF 0 - SFC 0

STF 0 - SFS 0

Errors in the above sequences produce error messages E000-E003 as shown in Table II.

Subtest 2: Checks that the test select code does not cause an interrupt with the flag and control set on the card, and the interrupt system off. The sequence of instructions is shown below:

```
STF  CH

STC  CH

CLF  0
```

The CLF 0 instruction should inhibit an interrupt from occuring. Error message E004 occurs if CLF 0 fails.

Subtest 3: Checks the ability to clear and set. The following instruction combinations are tested:

```
CLF CH - SFC CH

CLF CH - SFC CH

STF CH - SFC CH

STF CH - SFS CH
```

Errors in the above sequences produce error messages E005-E010 as shown in Table II.

Subtest 4: Checks that the flag of the card under test is not set when all other select code flags are set. Error message E011 occurs if a flag is set incorrectly.

Subtest 5: Checks the ability of the card under test to interrupt. With the flag and control set and the interrupt system on, there should be an interrupt on the channel. If not, error message E014 occurs. Checks are also made to insure that the interrupt occurred where expected. The interrupt should not occur before a string of priority affecting instructions are executed.

The following instructions are used to check that they hold off the interrupt during their execution:

```
STC 1

STF 1

CLC 1

CLF 1

JMP *+;

DEF *+1

JSB *+1

DEF *+1

NOP
```

Error messages E012 and E015 will occur if this is not true. The instructions being executed prior to and just after the interrupt are checked to see that they execute properly. If they do not, error message E026 will occur. Checks that another interrupt does not occur when the interrupt system is turned back on. Error message E013 will occur if the above is not true.

Subtest 6: Checks that with the interrupt system on and the CH control and flag set, there is no interrupt following a CLC CH instruction. The following sequence of instructions are used:

```
STC CH

STF CH

STF 0

CLC CH
```

If the CLC CH fials to inhibit an interrupt, error message E016 will occur. Checks that the CLC 0 instruction inhibits interrupts when the CH control and flag are set: The following sequence of instructions is used:

CLF CH

STC CH

STF CH

STF 0

CLC 0

If the CLC 0 fails to inhibit an interrupt, error message E017 will occur.

Subtest 7:* Checks that the PRESET (EXTERNAL and INTERNAL if applicable) buttons on the front panel perform the following actions;

1. Sets all flags (EXTERNAL).
2. Clears all control (EXTERNAL).
3. Turns off the interrupt system (INTERNAL).
4. Clears the I/O data lines (EXTERNAL).

Error messages E020-E023 will occur if an error occurs in the above tests.

6.2 Test 1 Initial Clear Controller and Unit Selection

Subtest 1: Checks that tape controller clears. If the clear or any other commands are rejected, then error message E027 will occur. If the clear command fails to execute within the required time error message E030 will occur.

Subtest 2: Selects tape units 0 through 3 and outputs status on list device (message H034). An additional test is made for unit selection identification if a 13183 interface is used. Error message E031 will result if unit ID is in error.

Error message E032 will occur any time there are no units on-line.

NOTE: See Table III for octal representation of the status word.

Subtest 3: Checks switch register bits 0-3 and verifies the corresponding tape units are on-line. If switch register settings do not correspond to tape units, error message E033 will occur. If bits 0-3 are clear, no check will be made.

6.3 Test 2 Beginning of Tape (BOT) Check

Subtest 1: Checks status of tape unit and verifies unit is at beginning of tape (BOT). If the unit is not at load point (BOT), a rewind command is issued and BOT condition is checked. If any rewind fails, error message E035 will result.

Subtest 2: Executes a gap command and checks the status to assure tape unit moved off load point. Error message E036 will result if the gap command fails.

Subtest 3: Executes a rewind command and checks for BOT condition.

Subtest 4: Issues a rewind command at BOT and waits for a maximum rewind reset time. Error message E040 will occur if the controller busy bit is still set.

The maximum rewind reset time is defined as follows:

TAPE SPEED (ips)	TIME (milliseconds)
12.5	3
25	2
37.5	1
45	1

NOTE: The Diagnostic condigurator has only a 1 millisecond resolution and a minimum time of 1 millisecond.

6.4 Test 3 Command Reject at Beginning of Tape (BOT)

Subtest 1: Checks the tape unit under test is at BOT; if not, a rewind command is issued.

Subtest 2: Attempts a backspace record command (BSR) and checks the status for a command reject. If the command reject bit fails to set, error message E041 will result.

Subtest 3: Attempts a backspace file command (BSF) and checks status for command reject. If the command reject bit fails to set, error message E041 will result.

6.5 Test 4 Write Command Execution Time

Subtest 1: Issues a gap command to move tape off BOT. Issues a write command on completion of the previous gap command, and waits 16 system clock pulses (SCP) for the 13183 or waits 21 SCP's for 13181 interface. If the data channel flag is not set within the time constraint, error message E047 will result. An additional 10 per cent is added to the above timing constants.

Subtest 2: Issues a clear command to stop tape motion started in subtest 1. If the clear command fails to stop tape motion, error message E043 will result.

The maximum write start-up time is defined as follows:

TAPE SPEED (ips)	13181	13183
12.5	35	46
25.0	18	23
37.5	12	15
45.0	10	13

6.6 Test 5 Gap Command Execution Time

Subtest 1: Issues a gap command to move tape unit off BOT: Error message E036 will result if a gap command fails to move the tape unit off BOT at anytime.

Subtest 2: Issues a gap command and the program waits for a minimum gap time. If the tape unit is not busy (gap too short), error message E051 will result.

Subtest 3: Waits the maximum gap time, and if the tape unit is still busy, error message E052 will result.

Subtest 4: Same as subtest 2, except that a gap file mark command is used.

Subtest 5: Waits for the gap command to finish and then, checks for an end of file condition. Clears the controller and backspaces over the file mark. The status is checked again to ensure the file mark was read.

The minimum gap time will be defined for diagnostic purposes to be:

1. The time it takes to move 4.8 inches of tape using a 13181 interface, minus 10 percent of this time.

2. The time it takes to move 3.0 inches of tape using a 13183 interface, minus 10 percent of this time.

The maximum gap time will be defined for diagnostic purposes to be:

1. The time it takes to move 4.8 inches of tape using a 13181 interface, plus 10 percent of this time.

2. The time it takes to move 3.0 inches of tape using a 13183 interface, plus 10 percent of this time.

The minimum gap time (in milliseconds) is defined as follows:

TAPE SPEED	13181	13183
12.5	344	216
25.0	173	108
37.5	115	72
45	96	60

6.7 Test 6 File Mark Command Test

Subtest 1: Places the tape unit at BOT.

Subtest 2: Writes a file mark and checks status for end of file (EOF) bit set. If the EOF bit is not set, error message E053 will result.

Subtest 3 (FSR): Issues a rewind command and verifies the tape unit is at BOT and the EOF bit is clear. Next, a forward space record command is issued and a check is made that the EOF bit is set.

Subtest 4 (BSR): Clears the controller and checks for status clear. If the status fails to clear, error message E043 will result. Next a backspace record command is issued and the status is checked for EOF. If the EOF bit fails to set at the appropriate time, error message E053 will result. Also, if the unit has returned to load point, error message E055 will occur to indicate an initial gap error.

Subtest 5 (FSF): Issues a rewind command and places the tape unit at BOT. Next, a forward space file command (FSF) is issued and a check is made to assure the tape unit is no longer at BOT and the EOF bit is set.

Subtest 6 (BSF): Clears the controller and issues a backspace file command (BSF). The status is again checked for EOF bit set.

Subtest 7: Returns tape unit to load point, and issues a write command. The program waits one gap time and then, verifies that the initial gap is not shorter than the minimum requirement.

6.8 Test 7 Multiple File Mark Test

Subtest 1: Writes one-hundred (100) file marks and checks the status after each file mark to assure the EOF bit is set. Error message E053 will result if the status is incorrect.

Subtest 2: Issues a series of 100 backspace record commands and checks that after each BSR command an EOF bit is set and that 100 file marks were read. Error message E064 will result if 100 file marks are not counted.

Subtest 3: If Subtest 2 passes, one-hundred (100) records are read using a read command, and a check is made that 100 file marks were read. Error message E064 will result if an improper number of file marks were read.

6.9 Test 10 Initial Write/Read Test

Subtest 1: Writes a one-hundred (100) word record of all ones and checks the status for data errors. Any data error which occurs during a write operation will cause error message E065.

Whenever there is a write error the following procedure will be used:

1. The record in question will be backspaced and rewritten three times.

2. If the record again fails to be written, a gap command will be attempted, and step one will be repeated.

3. Steps one and two will be repeated ten (10) times before the program aborts the current test.

4. The status will be reported everytime a write fails, except when the status is identical to the previous one.

5. The number of rewrites will always be reported.

Subtest 2: Backspaces the record previously written in subtest 1 and reads the record. A check is made for data integrity and content. Error message E066 will result if there is a status word error. Error message E062 will result if the input and output buffers do not agree in content and length.

Whenever there is a read error the following procedure will be used:

1. Ten rereads will be attempted before the program aborts the test.

2. The number of rereads will always be reported.

NOTE: 13181 only - The CRCC will be checked on every record written, but the CRCC check can be suppressed by setting switch register bit 7.

6.10 Test 11 125125 Read/Write Test

Subtest 1: Writes a one-hundred (100) word record in which each word is equal to 125125.

Subtest 2: Same comments as Test 10 - subtest 2.

6.11 Test 12 Force Data and Timing Error Status

Subtest 1: Writes a record of at least 100 words in length of all ones. Next a file mark is written and both file mark and record are backspaced.

Subtest 2: Forces data and timing errors by reading the record previously written in subtest one and not transfering any data to the computer during the read operation. If the data and timing error bits of the status word fail to set, error message E100 will occur.

Subtest 3: Backspaces the record previously read in subtest two, and overwrites that record with 64 words of all zeros followed by a clear command followed by a file mark. This procedure creates a record with a known parity error.

Subtest 4: Backspaces the record and filemark previously written in subtest three. A read forward file command (RFF) is issued and a status check is made upon completion of the read operation. If the EOF, data error, or odd byte bits in the status word are not set, error message E100 will result.

NOTE: The RFF command is not a supported hardware function. Its purpose in this diagnostic is limited to forcing data errors and thus checking the corresponding status bits.

6.12 Test 13 Record Spacing Test

Subtest 1 and 2: Writes two records of length 100 words. The first record is composed of all ones and the second consists of 125125 pattern in each word.

Subtest 3: Clears the controller and issues a backspace record command (BSR). While the BSR command is executing, a select unit command is given. It should be noted that the select command addresses a logical unit other than the unit under test. If the command reject bit fails to set, then error message E041 will result. If the select unit command is not rejected, the status will be checked; if it is an 13183 interface, the ID and status will be reported. In any case, the current unit which was under test will be selected again.

NOTE: If subtest 3 fails, this test will be aborted.

Subtest 4: Issues a read record forward command (RRF) and during its execution, issues a BSR command and then checks the status word for the command reject bit to be set. If the command reject bit fails to set, then error message E041 will result.

Subtest 5: Issues two BSR commands followed by a FSR command. The second record is again read and error message E104 will result if it is the incorrect record.

NOTE: The correct record will be the second. The content is 100 words of 125125.

6.13 Test 14 File Spacing Commands

Subtest 1 and 2: Writes two records identical to those described in Test 12, Subtests 1 and 2. A file mark is placed at the end of each record.

Subtest 3: Issues a backspace file command (BSF) followed by a backspace record command (BSR). A record is then read and if it is not the second record written in subtest one, error message E104 will result.

Subtest 4: Issues a forward space file command (FSF) followed by two BSF commands. Another FSR command is issued followed by a RRF command. A record is then read and if it is not the second record written in subtest one, error message E104 will result,

NOTE: The correct record will be the second record. The content is 100 words of 125125.

6.14 Test 15 Clear Time Check During a Motion Command

Subtest 1 and 2: Writes one record using 100 words of all ones. The record is then backspaced and read for a check on data integrity.

Subtest 3: Issues a backspace record command (BSR). During the BSR command operation, a clear command is issued and the program waits for the maximum clear time. If the controller busy bit is not clear at the end of the delay period, error message E030 will result.

The maximum clear time is defined as follows:

TAPE SPEED (ips)	TIME (milliseconds)
12.5	35
25.0	18
37.5	12
45.0	10

6.15 Test 16 Interrecord Gap

Subtest 1: Writes two (2), one word records followed by a file mark. The first record contains one word of all "1's" and the second contains 100 words of all "2's". The two records are backspaced and checked for data integrity.

Subtest 2: Backspaces both records and begins a read forward file command (RFF). The first one word record sets the controller data flag which in turn starts a timer. The program waits for a delay period corresponding to the minimum interrecord gap (IRG) time: afterwhich, the data flag is checked. If the data flag is set, error message E112 will indicate the IRG is too short.

Subtest 3: Waits a second short delay period (maximum IRG time), and again checks the data flag. Error message E113 will result if the data flag is still not set (IRG time too long).

The IRG (interrecord gap) distance will be defined for diagnostic purposes as:

Minimum - .4 inches

Nominal - .6 inches

Maximum - 1.25 inches

The IRG times (milliseconds) for maximum and minimum are given below:

TAPE SPEED	45	37.5	25	12.5
MAX	27	33	48	96
MIN	9	11	16	32

6.16 Test 17 Negative Interrecord Gap Creep and Byte Time

Subtest 1: Writes two file marks followed by two records and another file mark. The first record is a one word record of all ones. The second record is one-hundred words in length, where each word is all 2's.

Subtest 2: Backspaces both records and begins a read forward file command (RFF). The first one word record sets the controller data flag which in turn starts a timer. After the data flag sets from the second record, the IRG time is stored for use in Subtest 3.

Subtest 3: Rewrites the second record and file mark ten (10) times. Both records are backspaced using BSF command and a forward space record command is issued to position the first record. The first record is then read to verify that it was not lost through negative creep. Error message E114 will result if the first record is lost through negative creep.

Subtest 4: Issues a RFF command and waits for the first one word record which sets the controller data flag and starts a timer. The program then waits a second delay period-up to a maximum of 3 seconds - for the data flag to set. If the IRG time recorded in subtest 2 is longer than the delay time determined in this test, error message E115 will result.

Subtest 5***: Writes 100 words of all "1's". Then backspaces, reads and checks for data integrity.

Subtest 6***: Backspaces the previously written record and reads the record using DMA (DCPC) and the interrupt method. When the data flag sets for data transfer, a timer is started and is terminated at the end of the read. Error message E116 will result if the record transfer occurs too soon and E117 if it occurs too late.

The maximum and minimum byte transfer times for a 100 word record are defined below:

CONTROLLER	45	37.5	25	12.5 (ips)
13183 max	3	4	6	11
min	2	3	4	9
13181 max	6	8	11	22
min	5	6	9	18

NOTE: Subtest 6 and 7 will be deleted if no DMA (DCPC) is available.

6.17 Test 20 Write/Read Single Rotating Bit Pattern

Subtest 1: Writes a record containing the data pattern and then backspaces over it. If a write error occurs, error message F065 will result.

Subtest 2: Reads the record previously written in subtest 1 and compares it to the contents in the output buffer. If a read error occurs, error message E062 will result.

NOTE: 1. See Table IV for data patterns.

2. The maximum record length is limited to memory core available or 1024 words, whichever is smaller. The minimum record length is 100 words.

6.18 Test 21 Write/Read Channel Sawtooth Pattern

Subtest 1: Comments are the same as Test 20, subtest 1.

Subtest 2: Comments are the same as Test 20, subtest 2.

6.19 Test 22 Write/Read Track Sawtooth Pattern

Subtest 1: Comments are the same as Test 20, subtest 1.

Subtest 2: Comments are the same as Test 20, subtest 2.

6.20 Test 23 Write/Read (non DMA (DCPC)) Random Data**

Subtest 1: Comments are the same as Test 20, subtest 1; except that, all operations are performed with the interrupt system on.

Subtest 2: Comments are the same as Test 20, subtest 2.

Subtest 3: Turns off the interrupt system. Reads the record in reverse and removes the CRCC and LRCC (contents of the first word) for use in the next subtest.

Subtest 4: Compares the CRCC and LRCC from the previous subtest, to computed values. Error message E135 will occur if a LRCC error is detected, and error message E141 results if a CRCC error is detected.

6.21 Test 24 DMA (DCPC) Channel 1 Write/Read with Random Data***

Subtests 1 and 2 are identical to subtests 1 and 2 in Test 23.

6.22 Test 25 DMA (DCPC) Channel 2 Write/Read with Random Data***

Subtest 1 and 2 are identical to subtests 1 and 2 in Test 23.

6.23 Test 26 Rapid Write Test

Subtest 1: Writes an all "1's" record of one-hundred words in length, ten (10) times in rapid succession on a single tape unit. If a data error occurs, error message E065 will result.

Subtest 2: Reads all records back and checks each record for data integrity. Any data errors will result in error messages E066 or E062.

6.24 Test 27 Echo Check on All on-line units

NOTE: This test will automatically be bypassed if only one unit is on-line.

Subtest 1: Writes one record of one-hundred words (each word contains the logical unit number of the tape drive) on all on-line tape units. Any data transfer errors will result in error message E065.

Subtest 2: Backspaces each on-line unit and reads the record previously written in subtest 1. Error message E125 will result if the logical unit number does not match its corresponding record contents.

Subtest 3: Repeats Subtest 1 with the exception that the tape units are selected in reverse order.

Subtest 4: Comments are the same as subtest 2.

6.25 Test 30 Controller Check for Multi-Unit Operation

NOTE: This test will be by passed if only one unit is on-line.

Subtest 1: Writes a record of random length and content on each on-line tape unit. This is done ten (10) times; if switch register bit six (6) is set, the process is continued until an EOT condition occurs.

Subtest 2: Backspaces all on-line units ten times. A record is read from each on-line unit and checked for data integrity. This process is continued until all records written in subtest I have been checked.

6.26 Test 31 Inter-Unit Compatibility (reel exchange)*

NOTE: This test will be automatically bypassed if there is only one unit on-line.

Subtest 1: Checks the tape unit under test for BOT condition: If not, issues a rewind command. Then, writes a record of random length and content on each on-line unit.

Subtest 2: Prompts the operator with message H126 to indicate a reel exchange and halts the computer to allow the operator to exchange reels; to continue, press RUN.

Subtest 3: Rewinds all on-line units and reads the first record and compares it to the original output buffer used in subtest 1. If the records fail to compare, error message E062 will result.

Subtest 4: The program halts again with message H127. If further reel exchanges are necessary, set switch register but 13 (loop on test), exchange reels and press RUN; otherwise, the program exits this test section.

6.27 Test 32 Write Ring Enable*

Subtest 1: Prompts the operator with message H130 to remove the write ring and then halts. After write ring removal, press RUN.

Subtest 2: Issues a write command and checks status for command reject. If the command reject bit fails, error message E043 will occur. If the file protect bit is not set, error E132 will occur.

Subtest 3: Prompts the operator with message H131 to replace the write ring and then halts. If the file protect bit is not clear, error message E042 will occur.

6.28 Test 33 Rewind Off-Line Checks*

Subtest 1: Issues a rewind off-line command to the first on-line tape unit. The previously on-line unit is checked for off-line status. Error message E136 will result if an on-line unit fails to go off-line. Then, prompts the operator with message H 137 to place the unit back on-line and then halts. The operator places the unit back on-line, and presses RUN. If the unit is still off-line, error message E140 will result.

The above procedure is repeated until each on-line unit is checked.

NOTE: To turn this test into a manual echo check see Table VI.

6.29 Test 34 Write All Ones Record**

NOTE: This test must be selected by the operator; It is not part of the standard test sequence.

Subtest 1: An all "1's" record is written until either a data error or end of tape occurs. If a data error occurs, error message E065 will result.

NOTE: This test is useful for locating errors on the tape medium and for head alignment.

6.30 Test 35 Read on All "1's" Record**

NOTE: This test must be selected by the user; it is not part of the standard test sequence.

Subtest 1: Reads an all "1's" record until a data error or an end of tape (EOT) condition occurs. On completion of the read to EOT, a slow rewind is used to bring the tape back to BOT. If a data error occur's, error message E066 or E062 will result.

NOTE: This test can be used to read a standard all "1's" test tape. See Table V for setup.

6.31 Test 36 Operator Service Routines*

This test is not part of the normal test sequence and must be entered through the test selection procedure outlined in the Operating Procedures section. For details, see the OPERATOR SERVICE ROUTINES section.

6.32 Test 37 Operator Design*

This test is not part of the normal test sequence and must be entered through the test selection procedure outlined in the Operating Procedures section. For details, see the OPERATOR DESIGN Section.

7.0 OPERATOR DESIGN SECTION

The following sections describe and define operator design for a magnetic tape environment.

7.1 General Description

Operator design is an aid to the operator to help isolate a problem to the component level. It allows the operator to design his own tests for looping on one given area or exercise a specific area that was found in error by the diagnostic.

The operator design program consists of a command processor, source statement file, a source statement translator, and a user buffer. The command processor accepts inputs from the operator and takes appropriate action. The source statement file is composed by the operator. The source statement file will be executed, on command from the operator, by the source statement translator. The source statement translator calls a subroutine specified by the source statement and passes any required parameters given by the operator. The user buffer is composed by the operator and is used as a data buffer by various subroutines during execution.

7.2 Operating Procedure

To enter the operator design, the operator must select Test 31 (See Section 4.4 - Test Selection). Operator design is not a standard test and therefore, is not entered when the standard test sequence is used. Operator Design is aborted if a console device was not configured in section 5.2.

The message "OPDSN" is printed when operator design is entered. This is followed by a @ symbol indicating the program is ready to accept inputs from the operator. The operator may now enter either a command or a source statement. All inputs must be followed by a carriage return-line feed. If an input is found incorrect the message "INPUT ERROR" will be printed followed by a @ symbol. If the operator notices the input error before the line feed key is depressed, he may press the rubout key followed by a carriage return-line feed, then enter the correct input.

To enter source statements the operator must enter:

1. A line number followed by a space. The line number (represented by NN in Section 7.5.0) must be in the range 1 to 9999.

2. A source statement listed in Section 7.5.0 (1 to 4 ASCII characters) followed by a space.

3. Any parameters required of the operator. The program allows for two parameters, but a statement may use only one or none. The parameters must be separated by a space. If the statement requires parameters and the operator does not enter them the parameters are assumed to be zero and the subroutine will default to a given set.

4. A carriage return-line feed.

After the operator has composed a source program, he then enters a GO command and the previously entered source Statements will be executed. After execution the @ symbol is output to the console to signal the user that the program has been completed and is ready for more inputs.

During execution the program will stop and return the @ symbol for the following reasons:

1. End of source statement file.

2. Switch register bit 9 was set. *

3. A ST was entered after a WAIT.

4. A STOP statement was executed.

To delete a line the operator enters the line number only and that line will be deleted.

* NOTE: Switch register bit 9 is used to abort GO. LF, LO, and LI commands. The switch should be cleared after the @ symbol appears on the console device: otherwise, switch register bit 9 will continue to abort commands.

7.3 Error Reporting

If during execution of a statement an error is detected the error message routine is used in the control program. A halt will occur (If bit 14 is not set) and requires the operator to press RUN. If the operator wishes to abort the rest of the operator design program, he can set bit 9 and press RUN.

There are several error messages that are in operator design that can not be suppressed. They are as follows:

LINE? (LINE NN)

This means the statement called for a different line number to continue execution other than the next sequential one, and the line number was not found (GOTO. GOSH, RTN, and SC).

GS OV (LINE NN)

More than 15 GS statements (subroutine levels) have stacked up without being cleared by a RTN statement.

QUEUE FULL

The area allocated to source statements has been filled and the statement just entered was not put in the file. Some statements must be deleted from the file before any new ones may be added.

7.4 Program Commands

Program commands are entered directly after the prompt @ and followed by CR/LF.

7.4.0 Summary

LF List Source Statement File

LO List User Output Buffer

LI List User Input Buffer

IL List User Input Buffer Length

CF Clear Source Statement File

CB Clear User Output Buffer

DB Define Buffer

GO Execute User Program (source file)

BY Exit Operator Design

7.4.1 List Source Statement File (LF).

When the LF command is entered the program will list the source statement file. The list will be in numerical order when output to the console device. The List command can be aborted by setting switch register bit 9. The switch must be cleared after the @symbol is output to the console.

7.4.2 List User Output Buffer (LO).

When the LO command is entered the program will list the user input buffer in sequence. The sequence number is enclosed by parenthesis and followed by the buffer contents. The contents are in octal format regardless of the data format input. The list command can be aborted by setting switch register bit 9. The switch must be cleared after the @ symbol is output to the console.

The LO command may be followed by two numbers. The first being the starting number for the list and the second the last number to be listed. If the last is not input, only one buffer location will be listed.

7.4.3 List User Input Buffer (LI).

When the LI command is entered, the program will list the input user buffer. This command is similiar to the LO command.

7.4.4 Input Buffer Length (IL)

When the IL command is entered, the program will list the input buffer count on the console device.

7.4.5 Clear Source Statement File (CF).

When the CF command is entered it clears all of the source statements.

7.4.6 Clear User Output Buffer (CB).

When the CB command is entered the program will clear the buffer count which means there is no data in the buffer.

The CB command may be followed by two numbers. These would be used to delete sections of the buffer. If only one number is supplied that buffer location only will be deleted.

7.4.7 Define Buffer (DB)

When the DB command is entered, the program will place input data from the console device into the user buffer.

This command may be followed by:

IA Insert ASCII (DBIA)

IK Insert Octal (DBIK)

RA Replace with ASCII (DBRA)

RK Replace with Octal (DBRK)

If only DB is entered the program will output to the console the current output buffer count. When using the insert command (DBIA-DBIK), if no number is supplied, the input data will be appended to the end of the buffer. If a number is supplied, the input data will be inserted after the location specified.

If using the Replace command (DBRA-DBRK) either one or two numbers must be supplied. The first number is the starting location and the second the last location of area to be replaced. If only one number is supplied, only that location will be replaced.

When using the Replace command the input data can be greater or less than the number being replaced. If greater, the extra data will be inserted in front of those output buffer locations that follow the last number of the parameter list. If less, those locations not being replaced are deleted.

When A is specified the following input is placed in the user buffer in unpacked format, each character is one location.

If K is specified the following input is converted and placed in the user buffer. The octal input will accept a string of octal numbers separated by a space.

The operator can enter a packed ASCII string by specifying octal then input pairs of ASCII character separated by a space. If more than two characters are together between spaces, only the first two will be used.

When input is complete (carriage return-line feed) or 72 characters are entered, the program will ask "DONE?".

If the input is not complete enter "NO" and continue with input. If the input is complete enter "YES" and the current buffer count will be output followed by the @ symbol.

7.4.8 Execute User Program (GO).

The GO command will start the execution of the source statement file. The execution will start at the lowest current line number in the source statement file.

7.4.9 Exit Operator Design (BY).

When the BY command is entered the program will exit the operator design section and return to the standard test sequence of the main diagnostic.

7.5 Program Statements

7.5.0 Statement Summary

All statements must be preceded by a number. If a statement is entered which has the same line number as a previously entered statement, it will replace it. This allows the operator to change a statement without deleting the current statement.

Summary (NN represents statement number)

A. Program Control Statements

NN	GOTO X	Go line X.
NN	GOSB X Y	Go to subroutine starting at line X and repeat it Y number of times.
NN	RTN	Return to the last GOSB line number +1 (If no repeat count).
NN	WAIT	Wait for the operator.
NN	MSG X Y	Output "* XY" on the console (see 7.5.6).
NN	DLY X	Delay further execution by X number of milliseconds.
NN	TEST X	Execute Test number X (where X is an octal number).
NN	STOP	Terminate execution of user program.
NN	CNT	Increments and outputs a counter each time it is executed.

B. Peripheral Control Statements (magnetic tape unit)

NN	SP	Status report of magnetic tape unit.
NN	SC X Y	Branches to line X if tape unit status is not equal to Y.
NN	TC	Executes tape unit command (see Table VII).

```
NN  SFC X Y   Branches to line X if channel Y flag
              is clear.

NN  SD  X Y   Places standard data patterns in user buffer.

NN  WORD X Y  Places special data pattern in user buffer

NN  RD        Reads a record.

NN  WR        Writes a record.

NN  COMP      Compares input buffer to output buffer.

NN  CRC       Outputs current CRCC from tape unit.

NN  CRCI      Computes CRCC from input buffer.

NN  CRCO      Computes CRCC from output buffer.

NN  LRCI      Computes LRCC from input buffer.

NN  LRCO      Computes LRCC from output buffer.

NN  DMA  X    Read/write under DMA (DCPC) channel X.

NN  DMAW      Outputs DMA (DCPC) word count.

NN  INTR      Read/write with interrupt system on.

NN  TRAP X Y  Fills interrupt trap cell X with jump to line Y.

NN FLAG       Read/write under skip flag method.
```

7.5.1 Go to Line X (GOTO)

When executed the GOTO statement forces the program to continue execution at line X which was specified by the operator. The line number entered by the operator must be a decimal number and that line number must exist in the source statement file.

When executed, if the line specified does not exist, the nessage "LINE? (LINE NN)" will be output to the console followed by a @ symbol. All execution stops at this point.

7.5.2 Go to Subroutine (GOSB)

This is used to execute a section of program that is used several times during execution. The first number after the statement specifies the starting line number. Like the GOTO statement if the line does not exist, the program reports an error and then stops.

The second number specifies the number of times the program must execute the statements. This number may be omitted when entering the GOSB; if it is omitted, the program will execute the section only once.

The section of the file that is executed must be terminated by a RTN. If more than 15 GOSB statements (subroutine levels) are encountered before a RTN, the 16'th GOSB will be considered an error. The message "GS OV (LINE NN)" will be printed and the program will stop.

7.5.3 Return to Last GOSB +1 (RTN)

This is used to terminate a section of code that is used as a subroutine. It is used with the GOSB statement.

If a RTN is encountered prior to any GOSB statements, the message "LINE" (LINE NN)" will be output to the console, and execution will stop because there is no line number to return to.

7.5.4 Wait for Operator (WAIT)

When the program executes a wait statement the program outputs to the console "WAIT (LINE NN)" to inform the operator of the wait and where in the program it is. The operator must enter either "CO" for continue execution or "ST" for stop further execution.

The WAIT command is useful when the operator wishes to change something manually and wants the program to wait for him.

7.5.5 Message (MSG)

When executed the program will output to the console "*XY" where X is any non-number IC, non-blank ASCII character except a minus sign (-) and where Y is any ASCII character. This is used by the operator to indicate what portion of the program is executing.

7.5.6 Delay (DLY)

This is used to delay further execution of the program. The minimum delay time is 1 millisecond and the maximum is 40,959 milliseconds. If 0 is entered the delay will default to the maximum.

7.5.7 Execute Test Number X (TEST)

This is used to execute one of the standard tests listed for the diagnostic where X is the test number in octal. If a test number equal to or greater than the operator design test number is selected, it is ignored.

7.5.8 Terminates User Program Execution (STOP)

When executed the STOP statement causes the program to terminate execution of the user program and to print "STOP X" where X is the line number of the STOP command.

7.5.9 Loop Counter (CNT)

When executed the CNT statement causes the program to output the current value of the loop counter and increment it. CNT can be used only once in a user program. This statement is useful in counting the number of times a given section of a user program is executed.

7.5.10 Status Report (SR)

When executed the SR statement causes the program to print the status of the currently selected tape unit.

7.5.11 Status Compare (SC)

When the program executes a SC statement, it compares the current tape unit status to Y (octal), if it is not the same then the program will go to line X (integer) and continue. If X is not present, error message "LINE? (LINE NN)" will result. The default value for Y is zero.

7.5.12 Executes Tape Command (TC)

When the program executes a TC statement where TC is the mneumonic for one of the allowed tape commands (Table VII), it outputs it to the currently selected tape unit.

Remember to select a tape unit; otherwise, the last unit selected during the diagnostic will be used.

7.5.13 Branches if Flag Clear (SFC)

When the program executes a SFC command, it branches to line X if the flag on channel Y is clear. If X is not present or does not exist in the source program error message "LINE" (LINE NN)" will result. If Y="C", Y represents the command channel. If Y="D", Y represents the data channel. The default value for Y is Y="C" the low priorty channel.

7.5.14 Place Standard Data Pattern in User Output Buffer (SD)

When the program executes a SD statement, it places standard data pattern X in the user output buffer. If X is not one of the standard data patterns, the octal equivalent of X is used as the pattern.

Y represents the number of output buffer locations filled by the data pattern. X must be present if Y is present. The default value for Y will be limited by available core and is dependent on the core size, in any case it will be a number large enough to fill the entire user output buffer. If Y is larger than the maximum allowable size, an error message will result.

Each time a valid SD command is executed the output buffer count reflects the new value and the old contents of the output buffer are lost.

The following are allowed values for X:

RA	Random data
SR	Rotating 1 bit pattern
TR	Track sawtooth
CH	Channel sawtooth
ON	All ones
ZE	All zeros
FR	"125125" pattern

7.5.15 Place Special Data Pattern in User Output Buffer (WORD)

When the program executes a WORD statement, it places a special data pattern X in the user output buffer. The octal equivalent of X is used as the pattern.

Y represents the number of output buffer locations filled by the data pattern. X must be present if Y is present. The default value for Y will be limited by available core and is dependent on the core size. In any case it will be a number large enough to fill the entire user output buffer. If Y is larger than the maximum allowable size, an error message will result.

Each time a valid WORD command is executed the output buffer count reflects the new value and the old contents of the output buffer are lost.

7.5.16 Read Record (RD)

When the program executes a RD statement, it reads in the next record and stores it in the user input buffer area. If there is a read error, the same procedure is followed as in the main diagnostic.

7.5.17 Write Record (WR)

When the program executes a WR statement, it writes the contents of the user output buffer onto tape. If there is a write error, the same procedure is followed as in the main diagnostic. If the user output buffer is empty, error message "NO OUTPUT BUFFER (LINE NN)" will result.

7.5.18 Compare Buffer (COMP)

When the program executes a COMP statement. It compares the input buffer to the output buffer. If the data buffers do not compare, the following error messages result:

TAPE BYTE IS 777777

DATA WORD IS XXXXXX and should be YYYYYY

7.5.19 Read CRCC from Tape (CRC)

When the program executes a CRC statement, it reads in the CRCC from the selected tape unit and outputs it to the console service.

7.5.20 Compute CRCC from Input Buffer (CPCI)

When the program executes a CRCI statement, it computes the CRCC from the input buffer and outputs it to the console service.

7.5.21 Compute CRCC from Output Buffer (CRCO)

When the program executes a CRCO statement, it computes the CPCC from the output buffer and outputs it to the console device.

7.5.22 Compute LRCC from Input Buffer (LRCI)

When the program executes a LRCI statement, it computes the LRCC from the input buffer and outputs it to the console device.

7.5.23 Compute LRCC from Output Buffer (LRCO)

When the program executes a LRCO statement, it computes the LRCC from the output buffer and outputs it to the console device.

7.5.24 Read/Write Under DMA (DCPC) Control (DMA)

When the program executes a DMA statement, all subsequent RD and WR are executed under DMA (DCPC).

7.5.25 Output DMA (DCPC) Word Count (DMAW)

When the program executes a DMAW statement, it outputs the DMA (DCPC) word count of the currently selected DMA (DCPC) channel to the console device.

7.5.26 Read/Write with Interrupt System on (INTR)

When the program executes a INTR statement, the interrupt system is turned on and all subsequent RD and WR are executed under interrupt control.

7.5.27 Skip if Interrupt Occurs (TRAP)

When the program executes a TRAP statement, and if the interrupt system is on, it places a jump to line number Y in select code X. All subsequent interrupts on select code X will cause program execution to continue on line Y.

The select code X should range from 6 to 77 and Y must be a line number used in the user generated program.

Caution should be exercised when using the TRAP command. The Trap command should be used just prior to the section where an interrupt is expected in the user program. The Trap command links are usually destroyed by a RD or WR statement. The TRAP statement can be used several times in a user program, but the line number used in the most recently executed TRAP statement will be used in subsequent statements.

7.5.28 Read/Write Under Flag Control (FLAG)

When the program executes a FLAG statement, it turns the interrupt system off and executes subsequent program statements under flag control. All subsequent RD and WR are executed under flag control.

7.6 Example

Objective: Write 100 words of random data followed by a file mark on unit 0. Read the data back and compare the input to the output.

COMMAND	DESCRIPTION
OPDSN	Program Prompt
@10 SD RA 100	Setup Output Buffer
@20 SEL0	Select Tape Unit 0
@30 WR	Writes Record
@40 WFM	Write File Mark
@50 SFC 50	Wait for Flag
@60 BSR	Backspace Record
@70 SFC 70	Wait for Flag
@80 BSR	Backspace Record
@90 SFC 90	Wait for Flag
@100 RD	Read the Record
@110 COMP	Compares Buffers
@120 STOP	Terminates the Program (Optional)
@GO	Executes the Above Program
STOP (line 00120)	Stop

NOTE: Output from LI, IL and LO has been deleted.

@LO	List Buffer on console device
@LI	List Input Buffer on Console Device
@IL	List Input Buffer Length on Console Device

Objective: Write 100 words of random data followed by a file mark on unit 0 with the interrupt system on. Read the data back and compare the input to the output.

COMMAND	DESCRIPTION
OPDSN	Program Prompt
@5 INTR	Turn On Interrupt System
@10 SD RA 100	Setup Output Buffer
@20 SEL0	Select Tape Unit 0
@30 WR	Writes Record
@35 TRAP 11 55	Setup Trap Cell Jump to Line 55
@40 WFM	Write File Mark
@50 GOTO 50	Wait for Interrupt
@55 TRAP 11 75	Setup Trap Cell Jump to Line 75
W60 BSR	Backspace Record
@70 GOTO 70	Wait for Interrupt
@75 TRAP 11 100	Setup Trap Cell Jump to Line 100
@80 BSR	Backspace Record
@90 GOTO 90	Wait for Interrupt
@100 RD	Read the Record
@110 COMP	Compares Buffers
@120 STOP	Terminates the Program (Optional)
@GO	Executes the Above Program
STOP (line 00120)	STOP

NOTE: Output from LI, IL and LO has been deleted.

@LO	List Buffer on Console Device

COMMAND	DESCRIPTION
@LI	List Input Buffer on Console Device
@IL	List Input Buffer Length on Console Device

8.0 TELETYPE MESSAGES

There are two types of messages: program and error. All message data is in octal. The program messages include the following:

1. Introductory message.

2. Operator messages.

Program messages occur only if switch register bit 10 is clear. Error messages are printed only if switch register bit 11 is clear. Table II lists all messages.

9.0 COMPUTER HALTS

All halts may be restarted at address 2000. The only exception is a 106077 (unexpected trap cell halt) which is often irrecoverable. The specific computer halts are shown in Table II.

NOTE: See Table IIa for a summary of halt information. See Table IIb for error and information describing each halt.

10.0 OPERATOR SERVICE ROUTINES

Four separate operator-service routines of the diagnostic allow the operator, using various combinations of the routines, to perform checkout verification procedures. The four routines are: Write Tape Byte from Switch Register. Write Computer word from Switch Register. Command Exercise, and DMA (DCPC) Transfer Test.

This section is entered by selecting Test 30. To exit this routine, wait for halt 106046 (message "SELECT OP. SER.") and clear the switch register and press RUN.

NOTE: All error messages are suppressed throughout this test.

Switch register settings at halt 106046 (message ("SELECT OP. SER.") are defined as follows:

SWITCH	STATE	DESCRIPTION
0	Set	Write tape byte from Switch Register
1	Set	Write word from Switch Register
2	Set	Command exercise
3	Set	DMA (DCPC) Byte Transfer
4-15		Not defined
0-15	Clear	Exits Test 30

10.1 Write Tape Byte from Switch Register

This routine is selected by setting switch register bit 0 at halt 106046. After halt 106047 (message "SELECT BYTE") occurs, make the appropriate selection of switch register options from Table X, then press RUN.

Two types of records can be written, depending upon the use of the switch register. Table X provides switch register settings for different lengths or records, as well as settings for use during write and termination-of-write operation. Switch register bits 0 through 7 determine the bit pattern of the bytes to be written.

Placing switch register bit 15 in the up position halts the fixed length record operation at the end of the record being written. This routine also permits all "1's" to be written. When the program detects end-of-tape, it causes automatic tape rewind to load point and continues writing records.

Setting switch register bit 15 brings the program to a normal halt 106046.

10.2 Write Computer word from Switch Register

This routine is selected by setting switch register bit 1 at halt 106046, and then press RUN. After halt 106050 (message "SELECT WORD") occurs, make the appropriate selection of the switch register (see Table XI) and press RUN.

This routine allows the operator to write a computer word on

tape. The higher eight bits represents the first byte that will go on tape, and the lower eight represents the second word. The maximum length record written with this routine is 2048 bites (1024 words).

This routine contains the same end-of-tape provision as section 10.1.

Changing any switch register bit brings the program to a normal halt 106046.

10.3 Command Exercise

This routine is selected by setting switch register bit 2 at halt 106046, and then pressing RUN. After halt 106051 (message "SELECT COMMAND") occurs, make the appropriate switch register settings from Table XII and press RUN.

This routine outputs individual commands listed in Table XII to the controller and tape unit. Any combination of commands in Table XII can be used. The order of execution is from right to left (from bit 0 to 14). The routine has the option of using the flags for termination of operations or as a timer.

In the timer mode, three fixed time periods are avilable. These are 10, 15 and 30 milliseconds.

Normal termination of operations in this routine is achieved by setting switch 15 to the up position (halt 106046).

10.4 DMA (DCPC) Transfer Test

This routine is selected by setting switch register bit 3 at halt 106046, and then pressing RUN. After halt 106052 (message "SELECT DMA BYTE") occurs, make the appropriate switch register settings (see Table XIII) and press RUN.

This routine is used as an extended method for checking DMA (DCPC) transfer mode of the interface. Switches 0 through 7 determine the bit pattern of the bytes to be written.

This routine writes a 2048-byte record, then backspaces and reads the record.

Setting switch 15 brings the program to a normal halt 106046. Leaving switch 15 cleared allows the program to continue transferring records until an end-of-tape condition is detected, at which time the tape automatically rewinds.

11.0 LIMITATIONS

The following limitations exists:

a. A teleprinter is needed if operator design is used.

b. 8K of core (minimum) is required. If only 8K of core is available, the program can not be reconfigured and the maximum buffer length is a little over one-hundred (100) words.

   If reconfiguration is attempted by restarting at 100, error halt 102070 will occur. If RUN is then pressed, the program will jump to 2000 and begin program execution.

c. The maximum record length in all tests except 31 is 2048 bytes.

d. The ID burst on 13183 controller is not checked. The single track error status word bit is not forced in the 13183 controller.

e. The Byte Time transfer rate is not checked on units without DMA (DCPC).

12.0 The following tables can be used as condensed information with the preceding text.

Table I. SWITCH REGISTER SETTINGS

The following switch register settings are used for program control:

SWITCH	MEANING IF SET
0	Use Magnetic Tape Unit 0
1	Use Magnetic Tape Unit 1
2	Use Magnetic Tape Unit 2
3	Use Magnetic Tape Unit 3
4 *	Use DMA (DCPC) (Channel 1) on all Read/Write
5 *	Use DMA (DCPC) (Channel 2) on all Read/Write
6	Inhibit all tests with embedded rewinds.
7	Delete CRCC and LRCC check (13181 only).
8	Suppress Test which Require Operator Intervention
9	Go to User Test Selection Section At End of Current Test (Abort)
10	Suppress non-error Messages
11	Suppress Error Messages
12	Loop on Diagnostic (Also suppress tests which require operator intervention.)
13	Loop on Last Test
14	Suppress Error Halts
15	Halt 76 at end of Each Test

*If DMA (DCPC) is not available, the program will override switch register setting.

Table IIa. Halt Code Summary

HALT	MEANING
102000-102067	Error or information messages 00-67
106000-106067	Error or information messages 100-167
103000-103067	Reserved
107000-107067	Reserved

The above information does not allow any error or information halts to be defined between 70 and 77 escept as defined below:

102070	Reconfiguration was attempted in an 8k mode.
102071	13183 with no DMA
102072	Tape unit option error
102073	Select code input error
102074	Select code configuration complete
102075	User test sequence selection request.
102076	End of test (A= test number)
102077	End of diagnostic
106070-76	Reserved
106077	Trap cell halts in location 2-77
103070-107077	Reserved

Table IIb. Error and Information Messages

HALT CODE	SECTION	MESSAGE	COMMENTS
102070	Configuration	None	Attempted to reconfigure with BK of available core. Press RUN to restart diagnostic at 2000 or reload diagnostic to reconfigure.
102071	Configuration	None	13182 with no DMA. If the operator wishes to continue without DMA, set bit 9 and press RUN.
102072	Configuration	None	Tape speed or diagnostic type invalid. Select correct setting and press RUN.
102073	Configuration	None	I/O select code entered is invalid. Must be greater than 7. Reenter a valid select code and press RUN.
102074	Configuration	None	Select code entered during configuration valid. Enter program ontion bits to switch register and press RUN.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
102075	Test Control	None	Test selection request resulting from switch bit 9 being set. Enter to A/B-registers the desired group of tests and press RUN.
102076	Test Control	None	End of test halt switch register bit 15 being set (A-register = test number). To continue, press RUN.
102077	Test Control	PASS N	Diagnostic run complete (A-register = N, where N is the Number of passes). Switch register options may be changed or test selection change by setting bit 9 of the switch register. To continue, press RUN.
106077	Test Control	None	Halt stored in location 2-77 to trap interrupts which may occur unexpectedly because of hardware malfunctions. Diagnostic may be partially destroyed if halt occurs; the program may have to be reloaded. The problem should be corrected before proceeding.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
None	Test Control	7970-13181 7970-13183 Diag.	Introductory message.
None	Test Control	Text XX	Information message before error message (XX = test number). Message occurs for the first error within a test, but is suppressed for any subsequent messages within the same test.
102000	Test 0	E000 CLF 0-SFC 0 ERROR	CLF/SFC 0 combination failed. CLF did not clear flags or SFC caused no skip with flags clear.
102001	Test 0	E001 CLF 0-SFS 0 ERROR	CLF/SFS 0 combination failed. CLF did not clear flags or SFS caused skip with flags clear.
102002	Test 0	E002 STF 0-SFC 0 ERROR	STF/SFC 0 combination failed. STF did not set flags or SFC cuased skip with flags set.
102003	Test 0	E003 STF 0-SFS 0 Error	STF/SFS) combination failed. STF did not set flags or SFS caused no skip with flags set.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
102004	Test 0	E004 CLF 0 Did Not Inhibit Int	With card flag and control set, CLF 0 did not turn off interrupt system.
102005	Test 0	E005 CLF CH-SFC CH Error	CLF/SFC CH combination failed. CLF did not clear flag or SFC caused no skip with flag clear.
102006	Test 0	E006 CLF CH-SFS CH	CLF/SFS CH combination failed. CLF did not clear flag or SFS caused skip with flag clear.
102007	Test 0	E007 STF CH-SFC CH Error	STF/SFC CH combination failed. STF did not see flag or SFC caused skip with flag set.
102010	Test 0	E010 STF CH-SFS CH Error	STF/SFS CH combination failed. STF did not set flag or SFS caused no skip with flag.
102011	Test 0	E011 STF XX SET CARD FLAG	Select code screen test failed. XX= select code that caused that card flag to set.
102012	Test 0	E012 INT DURING HOLD OFF INSTR	Interrupt occurred during an I/O instruction or a JMP/JSB indirect instruction.

Table IIb. Error and Information Messages (cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
102013	Test 0	E013 SECOND INT OCCURRED	Card interrupt a second time After initial interrupt was processed.
102014	Test 0	E014 NO INT	No interrupt occurred with card flag and control set and the interrupt system on.
102015	Test 0	E015 INT RTN	Interrupt did not occur at the correct location in memory.
102016	Test 0	E015 CLC CH ERROR	CLC CH did not clear card control with the interrupt system on.
102017	Test 0	E017 CLC 0 ERROR	CLC 0 did not clear control with the interrupt system on.
102020	Test 0	E020 PRESET (EXT) DID NOT SET FLAG	PRESET (EXT) did not set the card flag.
102021	Test 0	E021 PRESET INTS) DID NOT DISABLE INTS	PRESET (INT) did not disable the interrupt system.
102022	Test 0	E022 PRESET (EXT) DID NOT CLEAR CONTROL	PRESET (EXT) did not clear control.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
102023	Test 0	E023 PRESET (EXT) DID NOT CLEAR I/O	PRESET (EXT) Did not clear I/O lines.
102024	Test 0	H024 PRESS PRESET(EXT/INT), RUN	Press PRESET (EXT/INT), then RUN.
None	Test 0	H025 BI-O COMP-DATA CH or H025 BI-O COMP-CMND CH	Basic I/O tests complete.
102026	Test 0	E026 INT EX-ECUTION ERROR	Instructions being executed prior to and just after interrupt, did not execute correctly.
102027	Test 1	E027 COMMAND REJECT	Results from any unpredicated command reject.
102030	Test 1	E030 CLR TIME-OUT	Clear Command failed to execute.
102031	Test 1	E031 ID ERROR	(13183 only) unit ID is in error.
102032		E032 NO UNITS UP	Occurs whenever there are no units on-line.
102033	Test 1	E033 UNITS OFF-LINE - SW	Set switch reg. Switch register settings do not correspond to unit status.
None	Test 1	H034 UNIT ON-LINE or H034 UNIT OFF-LINE	List tape unit(s) status

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
102035	Test 2	E035 REWIND ERROR	This message will occur any time a rewind command fails.
102036	Test 2	E036 GAP ERROR	This message will occur anytime a gap command fails to move the tape unit off BOT.
None		H037 EOT	Occurs whenever an EOT reached.
102040	Test 2	E040 REW TOO LONG	Unit failed to rewind within maximum time.
102041	Test 3	E041 CMND REJECT ERROR	Command reject bit in the status word failed to set.
102042		E042 NO WRITE RING	No write ring.
102043		E043 CLEAR ERROR	Clear command failed to clear controller.
102046			Reserved
102047	Test 4	E047 WRITE START TIME	Unit takes too long to begin writing a record.
102050		E050 RECORD LENGTH ERROR	Input and output buffer lengths do not agree.
102051	Test 5	E051 GAP TOO SHORT	Gap command executes too quickly. Gap is too short.
102052	Test 5	E052 GAP TOO LONG	Gap command executes too slowly. Gap is too long.
102053	Test 6	E053 FILE MARK ERROR	File mark bits in status word failed to set.
None		H054 COMMAND X	Occurs whenever there is an error message. X= the last command issued to the tape controller.
102055	Test 6	E055 INITIAL GAP	Initial gap before first record failed.
102056		E056 EOT BIT CLEAR	Occurs whenever an EOT is detected and fails to remain set after a gap command moves tape past EOT mark.

Table IIc. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
		H057 XX REWRITE(S)	xx=number of times a record was written.
		H060 XX REREAD(S)	xx= number of times a read was attempted.
102061		E061 BUFFER TOO LONG	Request buffer length too long.
102062		E062 DATA ERROR	Data error during data transfer. Input and output buffers do not compare.
102063			Reserved
102064	Test 7	E064 MISSED FILE MARKS	Failed to read 100 file marks.
102065		E065 WRITE ERROR	Status word indicates a write error.
102066		E066 READ ERROR	Status word indicates a read error during the last record.
None		H067 DATA WORD IS X AND SHOULD BE Y	x = word in octal. y = output word. Occurs whenever there is a data error.
106000	Test 10	E100 DATA ERROR OR ODD BYTE ERROR	Data, timing, or odd byte bits failed to set.
None		H101 TAPE BYTE COUNT X	Occurs whenever there is a data error. X is the number of bytes from the beginning of the record to the data error.
None		H102 RECORD X	Occurs whenever there is a data error. X is the number of records from BOT to the data error.
106003		E103 LP SET	Occurs whenever tape unit fails to move of BOT after forward motion.
106004	Test 13	E104 WRONG RECORD	Command failed to position tape unit properly.
106005-106011			Reserved

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
106012	Test 14	E112 IRG TOO SHORT	IRG gap too short.
106013	Test 14	E113 IRG TOO LONG	IRG gap too long.
106014	Test 15	E114 RECORD LOST	First record lost from negative creep.
106015	Test 15	E115 NEG. CREEP	Negative creep was detected.
106016	Test 15	E116 BYTE TIME SHORT	The byte transfer time is too short.
106017	Test 15	E117 BYTE TIME LONG	The byte transfer time is too long
106020-106024			Reserved
106025	Test 23	E125 ECHO ERROR	Tape units are failing to respond correctly to the echo check.
106026	Test 25	H126 EXCHANGE REELS	Operator prompt for inter-unit compatibility test.
106027	Test 25	H127 SET SW 13 TO LOOP	Operator prompt to set switch register 13 if more reels need to be exchanged.
106030	Test 26	H130 REMOVE WRITE RING	Operator prompt for write ring enable test.
106031	Test 26	H131 REPLACE WRITE RING	Operator prompt to replace the write ring.
106032	Test 26	E132 FILE PROTECT ERROR	File protect bit failed to set.
106033		E133 COMMAND FLAG	Unexpected command flag during write command.
106034			Reserved
106035		E135 LRCC ERROR	Error was detected in the LRCC during the last record. Note: This applies only to 13181 interface.
106036	Test 27	E136 UNIT ON-LINE	Unit failed to go off-line after a rewind off-line command.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	COMMENTS
106037	Test 27	H137 PUT UNIT ON-LINE	Prompts operator to place the tape unit back on-line.
106040	Test 27	E140 UNIT OFF-LINE	Tape unit failed to go on-line an should placed back on-line.
106041		E141 CRCC ERROR	Error was detected in the CRCC during the last record. Note: This applies only to 13181 interface.
106042-106043			Reserved
106044		E144 LOST DATA FLAG	Occurs whenever the data channel flag fails to set.
106045		E145 LOST COMMAND FLAG	Occurs whenever the command flag fails to set within 3 seconds.
106046	Test 30	H146 SELECT OP. SER.	Select one of the operator servic routines (10.0).
106047	Test 30	H147 SELECT BYTE	Select switch register options from Table X.
106050	Test 30	H150 SELECT WORD	Select word on switch register using Table XI.
106051	Test 30	H151 SELECT COMMAND	Select commands using Table XII.
106052	Test 30	H152 SELECT DMA BYTE	Select switch reg. settings for DMA transfer word using Table XII
106053			Reserved
None		H154 UNIT X	Occurs whenever there is another message. x=unit number (0-3).
None		H155 STATUS IS X H155 AND SHOULD BE Y	Occurs whenever there is an error message. X and Y are in binary format where 0= bit clear, 1=bit set.
106056			Reserved
106057		E157 NO DMA	There is no DMA.
106060		E160 COMMAND INT	Unexpected interrupt.

Table IIb. Error and Information Messages (Cont.)

HALT CODE	SECTION	MESSAGE	DESCRIPTION
106061		E161 DATA INT	Unexpected interrupt.
106062		E162 DMA INT	Unexpected interrupt.
106063		E163 LOST DMA FLAG	Lost DMA flag.
106064		E164 BUSY ERROR	Interface busy failed to set after a command.

Table IIc. Message Summary

A summary of messages which can occurr at any time.

HALT	MESSAGE	DESCRIPTION
102032	E032 NO UNITS UP	Occurs whenever there are no units on-line.
102035	E035 REWIND ERROR	See message E035.
None	H037 EOT	Occurs whenever an EOT reached.
102042	E042 NO WRITE RING	No write ring.
102043	E043 CLEAR ERROR	Clear command failed to clear controller.
102050	E050 REC LENGTH ERROR	Input and output buffer lengths do not agree.
102053	E053 FILE MARK ERROR	See Message E053
None	H054 COMMAND X	Occurs whenever there is an error message. x=the last command issued to the tape controller.
102056	E056 EOT BIT CLEAR	Occurs whenever an EOT is detected and fails to remain set after a gap command moves tape past EOT mark.
	H057 XX REWRITE(S)	xx=number of times a record was written.
	H060 XX REREAD(S)	xx=number of times a read was attempted.
102061	E061 BUFFER TOO LONG	Requested buffer length too long.
102062	E062 Data Error	Data error during data transfer. Input and output buffers do not compare.
102065	E065 WRITE ERROR	Status word indicates a write error.
102066	E066 READ ERROR	Status word indicates a read error during the last record.
None	H067 DATA WORD IS X AND SHOULD BE Y	X= word in octal. Y=Output Word. Occurs whenever there is a data error.
None	H101 TAPE BYTE COUNT X	Occurs whenever there is a data error. X is the number of bytes from the beginnin of the record to the data error.

Table IIc. Message Summary (Cont.)

HALT	MESSAGE	DESCRIPTION
None	H102 RECORD X	Occurs whenever there is a date error. X is the number of records from BOT to the data error.

Note record No. will be cleared whenever the following occurs:

1. Everytime a rewind occurs.
2. Anytime operator design exits.
3. Anytime the diagnostic is restarted.

106003	E103 LP SET	Occurs whenever tape unit fails to move of BOT after forward motion.
106033	E133 COMMAND FLAG	Unexpected command flag during write command.
106035	E135 LRCC ERROR	Error was detected in the LRCC during the last record. Note: This applies only to 13181 interface.
106041	E141 CRCC ERROR	Error was detected in the CRCC during the last record. Note: This applies only to 13181 interface.
106044	E144 LOST DATA FLAG	Occurs whenever the data channel flag fails to set.
106045	E145 LOST COMMAND FLAG	Occurs whenever the command flag fails to set within 3 seconds.
None	H154 UNIT X	Occurs whenever there is another message. X=unit number (0-3).
None	H155 STATUS IS X H155 AND SHOULD BE Y	Occurs whenever there is an error message. X and Y are in binary format where 0=bit clear, 1=bit set.
106057	E157 NO DMA	There is no DMA.
106060	E160 COMMAND INT	Unexpected interrupt.
106061	E161 DATA INT	Unexpected interrupt.
106062	E162 DMA INT	Unexpected interrupt.
106063	E163 LOST DMA FLAG	Lost DMA flag.
106064	E164 BUSY ERROR	Interface busy failed to set after a command.

Table IId. Typical Test Messages

Example of a rewind error.

```
H154 UNIT 0
H102 RECORD 000123
H054 COMMAND 000101
H155 STATUS IS      0 000 000 000 000 001
H155 AND SHOULD BE 0 000 000 001 000 000

TEST 02
E035 REWIND ERROR
```

Example of Test 01 output.

```
H154 UNIT 0
H034 UNIT ON-LINE
H155 STATUS IS       0 000 000 000 000 000
H154 UNIT 1
H034 UNIT OFF-LINE
H155 STATUS IS       0 000 001 000 000 001
H154 UNIT 2
H034 UNIT OFF-LINE
H155 STATUS IS       0 000 001 000 000 001
H154 UNIT 3
H034 UNIT OFF-LINE
H155 STATUS IS       0 000 001 000 000 001
```

Example of a read error

```
H154 UNIT 0
H102 RECORD 000123
H054 COMMAND 000023
H155 STATUS IS       0 000 000 000 010 010
H155 AND SHOULD BE   0 000 000 000 000 000

TEST 24
E066 READ ERROR
```

Table III. Status Word Description

DESCRIPTION	OCTAL REPRESENTATION	BIT NO.
Tape Unit Off-line (Local)	000001	0
Data Error	000002	1
File Protected (no ring)	000004	2
Command Reject	000010	3
Timing Error	000022	4
End of Tape (EOT)	000040	5
Load Point (BOT)	000100	6
End of File	000200	7
Interface Busy	000400	8
Tape Unit Busy	001000	9
Rewinding	002000	10
Odd Byte	004000	11
*Single Track Error	010000	12
*Selected tape Unit No.		13 and 14
0	000000	
1	020000	
2	040000	
3	060000	
*1600 CPI Density	10000	15

*Applies only to 13183 interface.

Table III. Status Word Description (Cont.)

Example: Assume 13181 interface which is file protected, and has a timing data and odd byte error.

File protect =	000004
Timing/data =	000022
odd byte error=	004000
Total status word	004026

Table IV. Data Patterns

BIT PATTERN DESCRIPTION	OCTAL REPRESENTATION
Single Rotating Bit	
	002001
	010000
	020100
	100002
	004004
	000420
	000040
	040200
	001010
Track Sawtooth	
	177773
	175352
	145212
	005010
	000000
Channel Sawtooth	
	177577
	037437
	007407
	001401
	000377
All "1's"	177777 etc.
All "0's"	000000 etc.

Table V. Read All "1's" Test Tape

Setup procedure for reading an all "1's" test tape.

1. Set switch register 9.
2. When the program halts, select the A-register and set to zero. Next, select the B-register and set bit 13 and clear all others.
3. Clear switch register 9.
4. Mount all "1's" tape without write ring.
5. Press RUN.
6. To repeat an all "1's" tape read, repeat step 5.
7. To terminate, set switch register 9.

Table VI. Echo Check

To turn Test 27 into a manual echo check do the following:

1. After the halt in subtest 1, set only one unit on-line.
2. Set switch register bit 13 (loop on test).
3. Set switch register bit 15 (halt at end of test).
4. Execute test.
5. At end of test select next unit.
6. Repeat step 4 and 5 until all units are tested.
7. Clear switch register bits 13 and 15.
8. Put all units to be tested on-line.
9. Press RUN to exit test.

Table VII. Standard Tape Commands

List of standard tape commands for the NN TC program statement in operator design.

MNEMONIC	OCTAL CODE	COMMAND GENERATED
CLR	110	Clears Tape Controller
BSR	41	Backspace Record
FSR	3	Forward Space Record
BSF	241	Backspace File
FSF	203	Forward Space File
WFM	211	Write File Mark
GFM	215	Gap and File Mark
GAP	15	Write 4.8(13181) or 3(13183) inches of Blank Tape
RRF	23	Read Record
WCC	31	Write Record
REW	101	Rewind
RWO	105	Rewind Off-line
SELO	1400	Select Tape Unit 0
SELI	2400	Select Tape Unit 1
SEL2	4400	Select Tape Unit 2
SEL3	10400	Select Tape Unit 3

Table VIII. Test Selection Settings

List of test with A/B-register settings.

BIT POSITION TEST NUMBER A REG	B REG	OCTAL	DECIMAL	TEST TITLE
0		0	0	Basic I/O
1		1	1	Initial Clear Controller and Unit Selection
2		2	2	Beginning of Tape (BOT)
3		3	3	Command Reject at BOT
4		4	4	Write Command Execution Time
5		5	5	Gap Command Execution Time
6		6	6	File Mark Command
7		7	7	Multiple File Mark
8		10	8	Initial Write/Read
9		11	9	125125 Write/Read
10		]2	]0	Force Data and Timing Error Status
11		13	11	Record Spacing
12		14	12	File Spacing
13		15	13	Clear Time Check During a Motion Command
14		16	14	Interrecord Gap
15		17	15	Negative Interrecord Gap Creep

Table VIII. Test Selection Settings (Cont.)

List of test with A/B-register settings.

BIT POSITION A REG	BIT POSITION B REG	TEST NUMBER OCTAL	TEST NUMBER DECIMAL	TEST TITLE
	0	20	16	Write/Read Single Rotating Bit Pattern
	1	21	17	Write/Read Channel Sawtooth Pattern
	2	22	18	Write/Read Track Sawtooth Pattern
	3	23	19	Write/Read (non DMA) Random Data
	4	24	20	DMA Channel 1 Write/Read with Random Data
	5	25	21	DMA Channel 2 Write/Read with Random Data
	6	26	22	Rapid Write
	7	27	23	Echo Check on All On-line Units
	8	30	24	Controller Check for Multi-Unit Operation
	9	31	25	Inter-Unit Compatibility
	10	32	26	Write Ring Enable
	11	33	27	Rewind Off-line
	12	34	28	Write All Ones Record
	13	35	29	Read An All Ones Record
	14	36	30	Operator Service Routine
	15	37	31	Operator Design

Table IX. Tests with Rewind Commands

List of tests with embedded rewinds.

TEST NUMBER	TEST DESCRIPTION
2	Beginning of Tape (BOT) Check
3	Command Reject at BOT
6	File Mark Command Test
25	Inter-Unit Compatibility
26	Write Ring Enable
27	Rewind Off-line Check

Table X. Settings for Writing Tape Byte

Switch register settings for writing tape from the switch register

SWITCH	STATE	FUNCTION
0-7	Optional	Defines the tape byte that is written, depending upon the state of the switch. Set=1, clear =0.
8*	Set	Fixed length record of 2 bytes.
9*	Set	Fixed length record of 4 bytes.
10*	Set	Fixed length record of 8 bytes.
11*	Set	Fixed length record of 16 bytes.
12*	Set	Fixed length record of 32 bytes.
13*	Set	Fixed length record of 64 bytes.
14*	Set	Fixed length record of 128 bytes.
R-14	Clear	Writes a maximum of 2048 bytes.
15	Set	Terminates the write operation .

* Note: Any combination of switches 8-14 may be set resulting in different lengths than stated above. If 8, 9, and 10 were set and the rest clear, the length of the record would be 14 bytes. The length is determined by the sum of the BCD weights (bit 8=1, bit 9=2, etc., bit 14=7) multiplied by 2.

Table XI. Setting for writing Tape Word

Switch register settings for writing tape from switch register word.

SWITCH	STATE	FUNCTION
0-15	Optional	Defines 2 consecutive tape bytes, 8-15 the first, and 0-7 the second. (SW Set=1 and SW Clear =0.)
0-15	Any change terminates the record and routine.	

Table XII. Settings for Command Exercise

Switch register settings for Command Exercise routine.

SWITCH	STATE	FUNCTION
0	Set	Write command is issued (WCC)
1	Set	Write file marks (WFM)
2	Set	Read record forward (RRF)
3	Set	Forward space record (FSR)
4	Set	Forward space file (FSF)
5	Set	Clear controller (CLR)
6	Set	Gap command (GAP)
7	Set	Backspace record (BSR)
8	Set	Backspace file (BSF)
9	Set	Rewind (REW)
10	Set	Rewind off-line (RWO)
11	Set	Clear Controller (CLR)

Table XII. Settings for Command Exercise (Cont.)

12	Set	10ms delay between commands.
13	Set	15 ms delay between commands.
14	Set	30 ms delay between commands.
15	Set	Terminates the routine.

Note:

Switches 0 and 9 set and all other switches clear causes the tape unit to write an ID burst if a 13183 controller is being used, followed by a rewind, write, and so on until bit 15 is set.

Table XIII. Settings for DMA Transfer

Switch register settings for DMA transfer routine.

SWITCH	STATE	FUNCTION
0-7	Set	Defines the characters being written on tape: set = 1, clear =0.
6	Set	Terminates the program.